**FIG. 1**

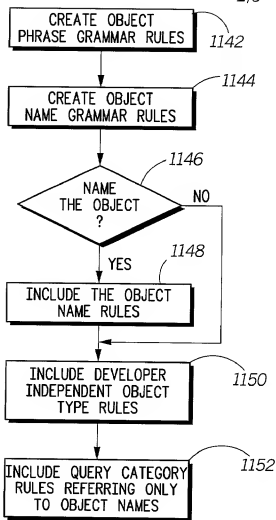


FIG. 2

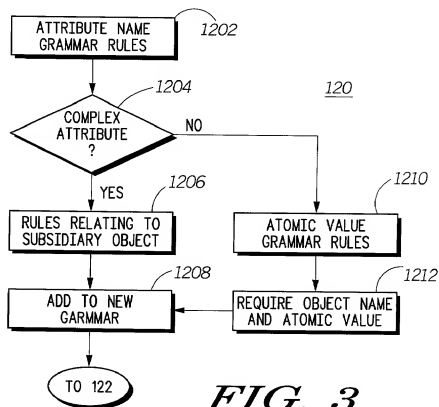


FIG. 3

100 —Semi-Automatic Induction of a Grammar from a Domain Model

102 —Create a new grammar, initially empty.

104 —Open a template grammar, with parameterized rules to be instantiated

106 —Create instances of general-purpose grammar rules

108 —Add the general-purpose rules to the new grammar.

For each broad category of queries

Make an umbrella rule to subsume rules for that type of query,
where an umbrella rule is a rule whose left-hand side is a Domain Object
independent non-terminal relating this rule to a broad category of rules, and
whose right-hand side is of a set of expansions of that non-terminal,
each a Domain Object specific instantiation of the broad category.

110 —For each Domain Object in the Domain Model

112 —Ask developer whether end users of the system will want to refer to this Domain Object
If response is yes

For each broad category of object phrases

1142 — Make an umbrella rule to subsume rules for that type of object phrase

1144 — Create corresponding object-name and object-name-poss grammar rules, where an
object-name-poss rule specifies the possessive form of the name of an object

1146 — Ask developer to supply one or more names for the object, offer the name of the Domain
Object as a default.

1148 — For each name entered by the developer, including the default if accepted
Add a right-hand side to the object-name rule expanding to the entered name
Add a right-hand side to the object-name-poss rule expanding to the possessive form
of the entered name.

Add the object-name and object-name-poss rules to the new grammar

1150 — For each type of object rule using the Domain Object name, but not requiring developer
Input

Retrieve the appropriate parameterized rule from the template grammar.

Specialize the retrieved template grammar rule for this Domain Object

Add the specialized rule to the new grammar

1152 — For each category of query rule that requires only the name of the Domain Object

Retrieve the appropriate parameterized rule from the template grammar.

Specialize the retrieved template grammar rule for this Domain Object

Add the specialized rule to the new grammar

Add a new right-hand side to the query-level umbrella rule of this category,
expanding to the left-hand side of the specialized rule.

Make umbrella rules to subsume rules for attributes of this Domain Object.

116 — For each Domain Attribute of this Domain Object

118 — Ask developer whether end user will want to refer to this Domain Attribute

120 — If response is yes

1202 — Make the grammar rules involving the name of this Domain Attribute and
optionally the name of this Domain Object, but not requiring any
developer input.

1204 — Add these grammar rules to the new grammar

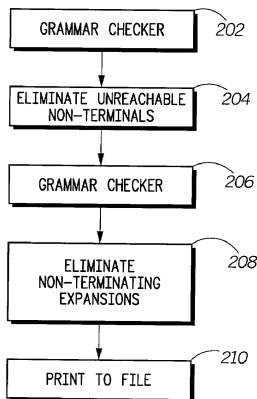
1206 — If this Domain Attribute is complex (i.e., represents a subsidiary Domain Object)
Create grammar rules for relating the subsidiary Domain Object to the
Domain Object

1208 — For each grammar rule created

Add it to the new grammar

Add a new right-hand side to the umbrella rule for this Domain
Object, expanding to the left-hand side of this rule

- Else (the Domain Attribute is simple)
- 1210 — Create grammar rules for the atomic values of this Domain Attribute
 - 1212 — Add these rules to the new grammar
 - 1214 — Create grammar rules that require the name of this Domain Object and the atomic value of this Domain Attribute
 - For each grammar rule created
 - Add it to the new grammar
 - Add a new right-hand side to the umbrella rules for this Domain Object, expanding to the left-hand side of this rule
 - Add the umbrella rules for the attributes of this Domain Object to the new grammar.
 - Add the query-level umbrella rules to the grammar

FIG. 4B200**FIG. 5**

- 200 — Detect and repair inconsistencies in the newly created grammar
- 202 — Run the grammar checker on the new grammar to find unreachable non-terminals
- 204 — For each unreachable non-terminal found by the grammar checker
 Prompt the developer to either delete all rules containing the unreachable non-terminal from
 the new grammar, or add new rules to make the non-terminal reachable.
 Offer as a default a top-level rule expanding the start symbol to the unreachable non-terminal
- 206 — Run the grammar checker on the new grammar to find non-terminating expansions
- 208 — For each non-terminating expansion found by the grammar checker
 Prompt the developer to either delete this expansion or add rules to terminate it.
 Offer as a default to delete this expansion
- 210 — Print the new grammar to a file

FIG. 6